User's manual

LD300 – LD301 – LD302 - LD303

Description

LD30x is an incremental multi-function display with impulse inputs for connecting incremental encoders or sensors. The user's interface is a multi-function keyboard fitted with 3 keys and a 7-segment and 6-digit LED display.
Model LD300 is a display only version; model LD301 provides an analogue output in addition; model LD302 further offers two presets and two switching outputs; finally model LD303 is equipped with a RS-232/RS-485 serial interface for connection with a PC.

Table of contents

1 - Safety summary
2 - Identification
3 - Mounting instructions
4 - Electrical connections
5 - Operating the front keys
6 - Operator menu
7 - Set up procedure
8 - Special functions
9 - Parameters list

1 Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic s.r.l. assumes no liability for the customer's failure to comply with these requirements.

1.2 Electrical safety

- Turn OFF power supply before connecting the device;
- connect according to explanation in section "4 - Electrical connections";
- in compliance with 2004/108/EC norm on electromagnetic compatibility, following precautions must be taken:

- before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
- power supply must be stabilized without noise; install EMC filters on device power supply if needed;
- always use shielded cables (twisted pair cables whenever possible);
- avoid cables runs longer than necessary;
- avoid running the signal cable near high voltage power cables;
- mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
- minimize noise by connecting the unit to ground (GND). Make sure that ground (GND) is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

1.3 Mechanical safety

- Install the device following strictly the information in the section "3 - Mounting instructions";
- do not disassemble the unit;
- do not tool the unit;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics of the device.

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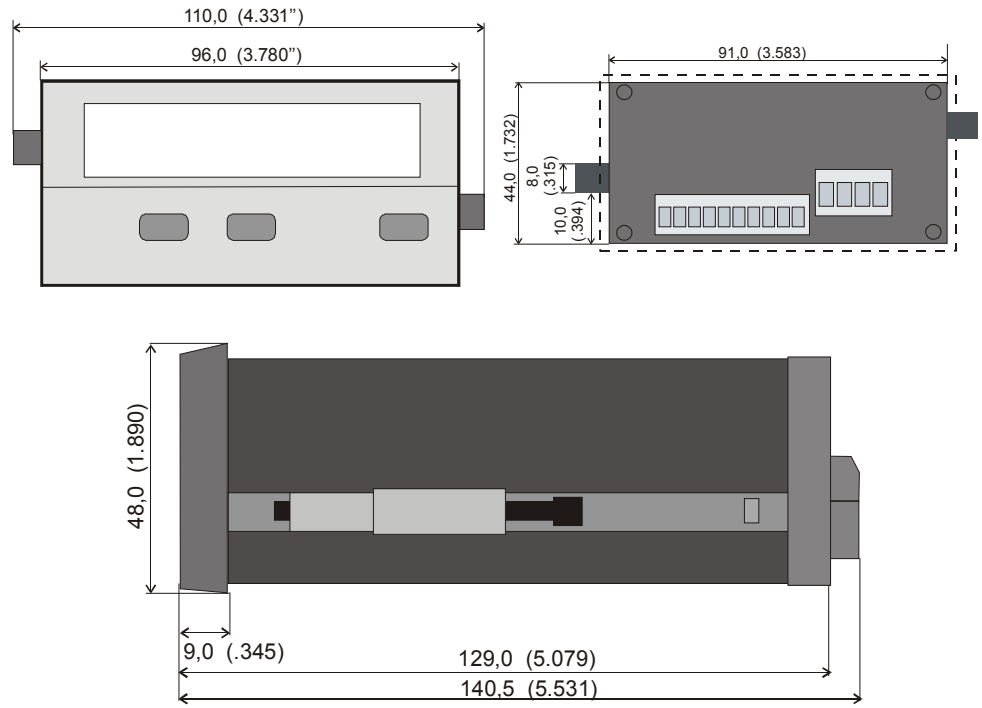
2 Identification

Device can be identified through the **ordering code** and the **serial number** printed on the label applied to its body. Information is listed in the delivery document too. Please always quote the ordering code and the serial number when reaching Lika Electronic s.r.l. for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product, refer to the technical catalog.

3 Mounting instructions

WARNING
Mount the unit with power supply disconnected.

Mount the display into the provided cut-out (approx. 91 x 44 mm) without panel clips.
Install panel clips on the display housing and screw until fixed.



Panel cut out: 91 x 44 mm (3.583 x 1.732")

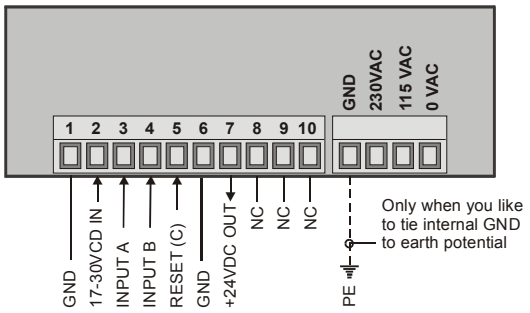
4 Electrical connections

WARNING
Turn OFF the power supply before connecting the device.

LD300
Display unit only

Special versions with TTL inputs (option -M8-) provide a +5V aux. output on terminal 7, instead of +24V

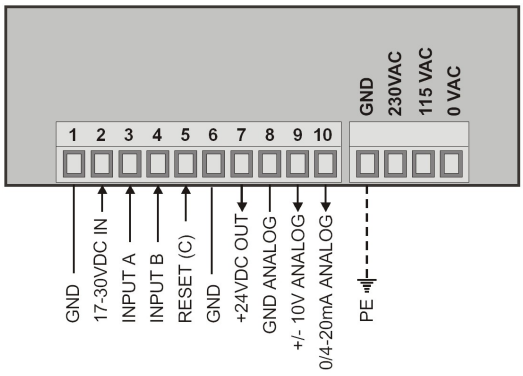
Units with option -P4- provide 24 / 42 VAC power supply instead of 115 / 230 VAC (option -PM-)



LD301
Display unit with analogue output

Special versions with TTL inputs (option -M8-) provide a +5V aux. output on terminal 7, instead of +24V

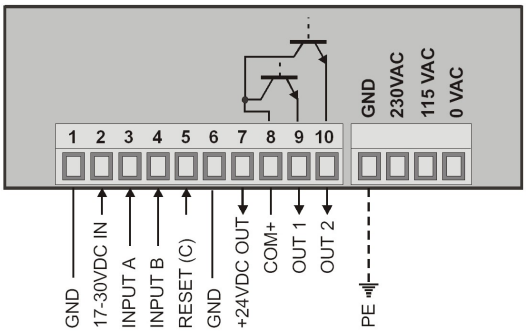
Units with option -P4- provide 24 / 42 VAC power supply instead of 115 / 230 VAC (option -PM-)



LD302
Display unit with 2 presets and transistor outputs

Special versions with TTL inputs (option -M8-) provide a +5V aux. output on terminal 7, instead of +24V

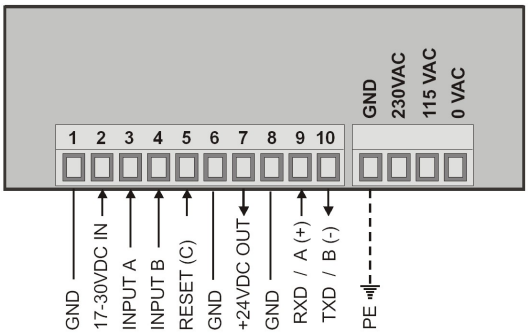
Units with option -P4- provide 24 / 42 VAC power supply instead of 115 / 230 VAC (option -PM-)



LD303
Display unit with serial interface

Special versions with TTL inputs (option -M8-) provide a +5V aux. output on terminal 7, instead of +24V

Units with option -P4- provide 24 / 42 VAC power supply instead of 115 / 230 VAC (option -PM-)



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4.1 Power supply

The unit accepts DC power supply from 17 V to 30 V when using terminals 1 and 2 and the consumption depends on the level of the supply voltage (typically between 80 mA and 150 mA plus current taken from aux. output).
For AC supply, terminals 0 VAC, 115 VAC or 230 VAC can be used. The total AC power consumption is 7.5 VA.
Units with option LD30x-P4-... are designed for either 24 VAC or 42 VAC power supply and the screw terminals are marked correspondingly.
The pictures in the previous page show a dotted line for grounding to PE. This connection is not necessary, neither for safety nor for EMC. However, with specific applications, it can be useful to ground the common potential of all signal lines.

NOTE
When using this earthing option, please note that:

1. all terminals and potentials marked "GND" will be earthed;
2. you should avoid multiple earthing, e.g. when you use a DC power supply where the Minus is already connected to earth etc. Especially under poor earthing and grounding conditions, multiple earth connections may cause serious EMC problems.

4.2 Aux. voltage output

Terminal 7 provides a 24 VDC / 120 mA max. auxiliary output for supply of sensors and encoders. Units with TTL inputs (option -M8-) provide a 5 VDC / 120 mA auxiliary output on terminal 7 instead.

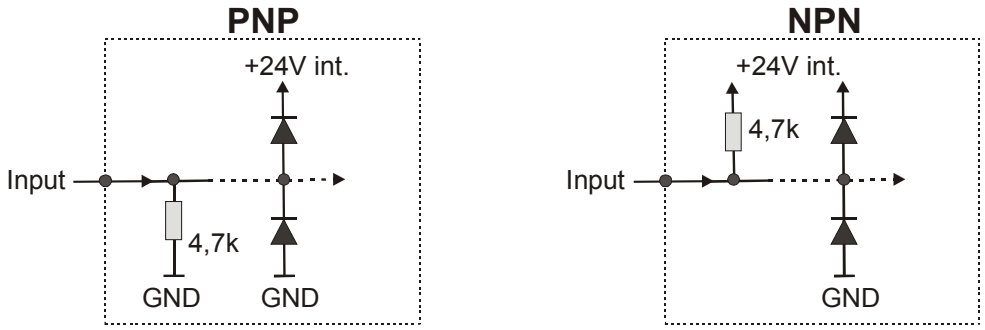
4.3 Inputs A, B and Reset

In the basic setup menu (see section "7.1 Basic settings" on page 14) these inputs can be configured to PNP (switch to +) or to NPN (switch to -). This configuration is valid for all three inputs at a time.
The factory setting is always PNP.
With standard units the input level is always HTL (Low < 2.0 V and High > 9.0 V).
Units equipped with option -M8- provide TTL / CMOS) level (Low <0.8 V and High >3.5 V).

NOTE

1. Independently of your setting, all functions of the unit are "active HIGH" and the unit triggers to positive transitions (rising edge).
2. With NPN setting please be aware that an open or unused RESET input is HIGH. Therefore the unit will be kept in a continuous RESET state and will not work, unless you tie the Reset line to GND (terminal 1 or 6).
3. When you use 2-wire NAMUR type sensors, please select NPN, connect the negative wire of the sensor to GND and the positive wire to the corresponding input.

Typical input circuit (standard version with HTL inputs):



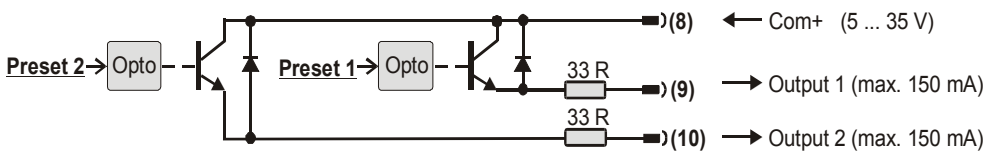
The counting inputs A and B are designed for input frequencies up to 100 kHz (with all counter modes) and up to 25 kHz (with all other operating modes).
The minimum pulse duration on the Reset input must be 500 µsec. (maximum frequency 1 kHz)
All inputs are designed to receive impulses from an electronic impulse source. Should you exceptionally need to **use mechanical contacts**, please connect an external capacitor between GND (-) and the corresponding input (+). With a capacity of 10 µF, the maximum input frequency will reduce to 20 Hz and miscounting due to contact bouncing will be eliminated.

4.4 Adjustable analogue output (LD301 model only)

A voltage output is available, operating in a range of 0 ... +10 V or –10 V ... +10 V according to setting. At the same time, a current output 0/4 – 20 mA is available. Both outputs refer to the GND potential and the signal polarity changes with the sign in the display. The outputs provide a 14-bit resolution and the response time at each change of the measuring value is approx. 7 msec. (f_{in} > 143 Hz).
The maximum current of the voltage output is 2 mA and the load on the current output can vary between 0 and max. 270 ohms.

4.5 Optocoupler / transistor outputs (LD302 model only) *

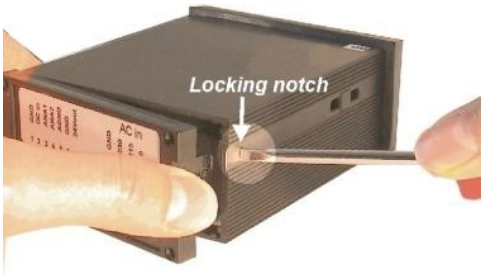
Outputs provide programmable switching characteristics and are potential-free. Please connect terminal 8 (COM+) to the positive potential of the voltage you want to switch (range 5V ... 30V). You must not exceed the maximum output current of 150 mA. If you switch inductive loads, please provide filtering of the coil by means of an external diode.



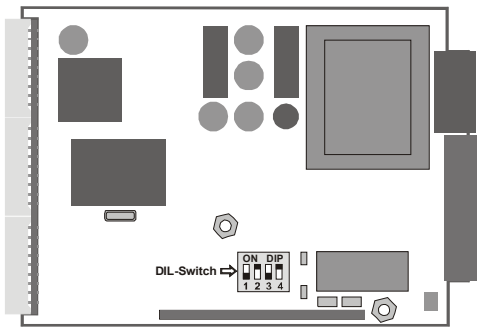
* For relay outputs please refer to model LD305.

4.6 Serial RS-232 / RS-485 interface (LD303 model only)

Ex factory the unit is set to RS-232 communication. This setting can be changed to RS-485 (2-wire) by means of an internal DIL switch. To access the DIL switch, please remove the screw terminal connectors and the back panel. Then pull the board to the rear to remove the PCB from its housing.

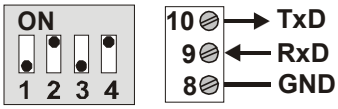


Removal of the back panel

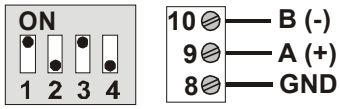


Location of the DIL switch

RS-232



RS-485



WARNING

1. Never set DIL switch positions 1 and 2 or DIL switch positions 3 and 4 to ON at the same time!
2. After setting the switch, shift the print carefully back to its housing, in order to avoid damaging the front pins for connection with the front plate.

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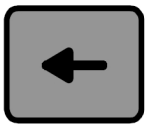
5 Operating the front keys

For setup and other operations the unit is fitted with three front keys which will be denominated as follows in the next pages:

		
ENTER (Input)	**SET** (Setting)	**CMD** (Command)

The functions of the keys are depending on the actual operating state of the unit.
The following three operating states apply:

- Normal display state (see section "5.1 Normal display state" on page 8)
- Setup state (see section "5.2 Selection and setting of parameters" on page 9)
  - Basic setup (see section "7.1 Basic settings" on page 14)
  - Operational parameters setup (see section "7.2 Operational parameters" on page 16)
- Teach operation (see section "5.3 Teach operation" on page 10)

5.1 Normal display state

NOTE
You can only change over to other operation states while the unit is in display state.

Change over to	Key operation
Basic setup	Keep **ENTER** and **SET** down simultaneously for 3 seconds
Operational parameter setup	Keep **ENTER** down for 3 seconds
Teach operation	Keep **CMD** down for 3 seconds

The **CMD** key is only used to execute the Teach procedure with linearization. For more details please refer to sections "8.1 Linearization" and "8.2 Manual input or „teaching" of the interpolation points" on page 30.

5.2 Selection and setting of parameters

5.2.1 Selecting a parameter

The **ENTER** key will scroll through the menu. The **SET** key allows to select the corresponding item and change the setting or the numeric value. After this, the selection can be saved by pressing the **ENTER** key again, which automatically changes over to the next menu item.

5.2.2 Changing parameter settings

With numerical entries, at first the lowest digit will blink. When keeping the **SET** key continuously down, the highlighted digit will scroll in a continuous loop from 0 to 9 and again from 0 to 9; and so on. After releasing the **SET** key, the actual value will remain and the next digit will be highlighted (blink). This procedure allows setting all digits to the desired values. After the most significant digit has been set, the low order digit will blink again and you can make corrections if necessary.
With signed parameters, the high order digit will scroll from "0" to "9" (positive) followed by "-" and "-1" (negative).

5.2.3 Saving settings

To save the actual setting, press the **ENTER** key, which will also automatically scroll forward the menu.

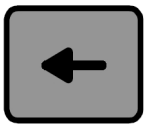
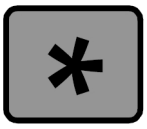
NOTE
At any time the unit changes from programming mode to normal display operation, when you keep the **ENTER** key down again for 3 seconds at least.

5.2.4 Time-out function

A "time-out" function will automatically terminate every menu level, when for a break period of 10 seconds no key has been pressed. In this case, all changes which have not been confirmed by **ENTER** yet would remain unconsidered.

5.3 Teach operation

NOTE
The time-out function remains disabled during all Teach operations.

Key	Function
	**ENTER** key will terminate or abort any Teach operation in progress
	SET function is fully similar to normal set-up operation
	**CMD** key will save the display value in the register and change over to the next interpolation point

For further details on the Teach procedure see section "8.2 Manual input or „teaching" of the interpolation points" on page 32.

5.4 Setting all registers to "Default" values

At any time you can return all settings to the factory default values.

WARNING
This action will reset all parameters to factory default values and your own settings will be lost. You will have to repeat your individual setup procedure.
Factory default values are shown in the subsequent parameter tables (see section "Parameters list" on page 34).

To reset the unit to default values:

- switch power off;
- press the **ENTER** key on the front;
- keep **ENTER** down while you power up again.

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5.5 Code locking of the keypad

When the code locking of the keypad has been switched on (see on page 15), any key access first results as follows:

To access the menu you must press the following key sequence:

within 10 seconds, otherwise the unit will automatically return to the normal display mode.

6 Operator menu

The menu provides one section with "Basic Parameters" (see section "7.1 Basic settings" on page 14)and another section with "Operational Parameters" (see section "7.2 Operational parameters" on page 16). On the display you will only find those parameters which have been enabled by the basic settings. E.g. when the Linearisation function has been disabled in the basic set-up, the associated linearization parameters will also not appear in the parameter menu.
All parameters, as good as possible, are designated by text fragments. Even though the possibilities of forming texts are very limited with a 7-segment display, this method has proved to be most suitable for simplification of the programming procedure.
The subsequent table shows the general structure of the menu.
Detailed descriptions of all parameters will follow in section "7 - Set up procedure" on page 14.

6.1 Overview of basic parameters

LD300	LD301	LD302	LD303
Type (Application mode)	Type (Application mode)	Type (Application mode)	Type (Application mode)
Input characteristics	Input characteristics	Input characteristics	Input characteristics
Brightness	Brightness	Brightness	Brightness
Code	Code	Code	Code
Linearization mode *	Linearization mode *	Linearization mode *	Linearization mode *
	Analogue output mode	Preselection mode 1	Serial unit number
	Analogue offset	Preselection mode 2	Serial format
	Analogue gain	Hysteresis 1	Serial baud rate
		Hysteresis 2	

* This only appears with Modes "RPM" and "Count".

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6.2 Overview of operational parameters

	Mode "RPM" (Tachometer) page 16	Mode "Time" (Baking Time) page 17	Mode "Timer" (Stopwatch) page 18	Mode "Count" (Counter) page 19	Mode "Speed" (Transition speed) page 20
LD300	Frequency	Display Format	Base (Resolution)	Counter Mode	Time
	Display Value	Frequency	Start/Stop	Scaling Factor	Display Value
	Decimal Point	Decimal Value	Auto Reset	Set Value	Decimal Point
	Wait Time	Wait Time	Latch Function	Reset/Set	Wait Time
	Average Filter	Average Filer		Decimal Point	
LD301	Frequency	Display Format	Base (Resolution)	Counter Mode	Time
	Display Value	Frequency	Start/Stop	Scaling Factor	Display Value
	Decimal Point	Decimal Value	Auto Reset	Set Value	Decimal Point
	Wait Time	Wait Time	Latch Function	Reset/Set	Wait Time
	Average Filter	Average Filer		Decimal Point	
	Analogue Begin				
	Analogue End				
LD302	Preselection 1				
	Preselection 2				
	Frequency	Display Format	Base (Resolution)	Counter Mode	Time
	Display Value	Frequency	Start/Stop	Scaling Factor	Display Value
	Decimal Point	Decimal Value	Auto Reset	Set Value	Decimal Point
	Wait Time	Wait Time	Latch Function	Reset/Set	Wait Time
	Average Filter	Average Filer		Decimal Point	
LD303	Frequency	Display Format	Base (Resolution)	Counter Mode	Time
	Display Value	Frequency	Start/Stop	Scaling Factor	Display Value
	Decimal Point	Decimal Value	Auto Reset	Set Value	Decimal Point
	Wait Time	Wait Time	Latch Function	Reset/Set	Wait Time
	Average Filter	Average Filer		Decimal Point	
	Serial Timer				
	Serial Mode				
	Serial Code				
All units	P01_H *			P01_H *	
	P01_Y *			P01_Y *	
	...			...	
	P16_H *			P16_H *	
	P16_Y *			P16_Y *	

* This only appears with modes "RPM" and "Count" when the linearization function has been enabled.

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7 Set up procedure

For better understanding the following sections "7.1 Basic settings" and "7.2 Operational parameters" explain settings related to the display only model (LD300). Model-specific settings for analogue output model (LD301), Preselections model (LD302) and Serial Link model (LD303) will be explained separately under sections from "7.3 Model LD301: additional settings for the analogue output" to "7.5 Model LD303: additional settings for the serial interface".

7.1 Basic settings

Customarily these settings have to be carried out one time only upon the very first use of the unit. The basic setup selects the desired operation mode of the unit, the input characteristics PNP/NPN and the desired brightness of the LED display.

NOTE
To access the Basic Setup press the **ENTER** and **SET** keys simultaneously for at least 3 seconds.

Menu		Setting range	Default
tYPE	**Operation Mode**		rPm
	Tachometer, frequency meter (see section "7.2.1 RPM, operation as tachometer or frequency counter").	rPm	
	Baking time / processing time indicator (see section "7.2.2 Time, display of baking or processing time (reciprocal speed)").	timE	
	Timer, Stopwatch (see section "7.2.3 Timer, Stopwatch").	timEr	
	Counter for position or event (see section "7.2.4 Count, Counter mode").	Count	
	Speed calculation from differential transition time (see section "7.2.5 Speed from differential time between a Start and a Stop input").	SPEEd	
CHAr	**Switching characteristics of the inputs**		PnP
	NPN, switch to "-"	nPn	
	PNP, switch to "+"	PnP	
briGht	**Brightness of the LED display**	20%, 40%, 60%, 80%, 100%	**100%**

Menu		Setting range	Default
CodE	**Keypad protection code**		no
	Keypad enabled continuously.	no	
	Keypad locked for any access.	All	
	Keypad locked, except for access to preselections 1 and 2 (LD302 only, see section "7.4 Model LD302: additional settings for preselections").	P_FrEE	
LinEAr	**Linearization mode *** For details please refer to sections "8.1 Linearization" and "8.2 Manual input or „teaching" of the interpolation points".		no
	The linearization is switched off.	no	
	Linearization settings for the positive range only (negative values will appear as a mirror).	1-qUA	
	Linearization over the full numeric range.	4-qUA	

* with Tachometer mode and Counter mode only.

7.2 Operational parameters

7.2.1 RPM, operation as tachometer or frequency counter

(Input A = frequency input, Input B not in use)

Menu		Setting Range	Default
FrEqu	**Frequency** Set a typical operating frequency for your application.	1 Hz to 25 000 Hz	**1000**
diSPL	**Display Value** Set the value you would like to see on your display with above frequency at the input.	1 ... 99999	**1000**
dPoint	**Decimal Point** Select the desired position as shown in the display. no decimal point decimal point at position 1 ---->: decimal point at position 5	 000000 00000.0 0.00000	**000.000**
WAit	**Wait Time** Define a "waiting time", this is the time expressed in seconds that the unit will wait from one input pulse to the next, before it sets the display to zero. When you enter "0", the unit will wait forever and show the last result until it receives the next input.	0.1 ... 99.9 sec	**1.0**
	The setting of this parameter automatically limits the minimum input frequency correspondingly. With "Wait" set to e.g. 0.1 sec. the unit will respond to frequencies > 10 Hz only and all lower frequencies will just display 0.		
FiltEr	**Average Filter** Selectable average filter to suppress unstable display with unsteady input frequencies. No filtering 2, 4, 8, 16 = number of floating average cycles.	 OFF 16	OFF

NOTE

LD301 model also provides a signed speed display with the +/- sign changing according to the direction of rotation (see section "7.3 Model LD301: additional settings for the analogue output").

7.2.2 Time, display of baking or processing time (reciprocal speed)

(Input A = frequency input, Input B not in use)

Menu		Setting Range	Default
diSFor	**Display Format** Select between seconds, minutes, minutes and seconds or minutes with two decimal positions. This will also automatically set your decimal point to the proper place. Seconds Minutes Minutes and seconds Minutes with two decimal positions	SEC min mi-SE min.00	SEC
FrEqu	**Frequency** Set a typical operating frequency for your application.	1 Hz to 25 000 Hz	**100**
diSPL	**Display Value** Set the value you would like to see on your display with above frequency at the input.	1 ... 999999	**100**
WAit	**Wait Time** Define a "waiting time", this is the time in seconds that the unit will wait from one input pulse to the next, before it sets the display to zero. When you enter "0", the unit will wait forever and show the last result until it receives the next input.	0.1 ... 99.9 sec	**5.0**
	The setting of this parameter automatically limits the minimum input frequency correspondingly. With "Wait" set to e.g. 0.1 sec. the unit will respond to frequencies > 10 Hz only and all lower frequencies will just display 0.		
FiLtEr	**Average Filter** Selectable averages filter to suppress unstable display with unsteady input frequencies. No filtering. 2, 4, 8, 16 = number of floating average cycles.	OFF 16	OFF

7.2.3 Timer, Stopwatch

Please note that open NPN inputs are always "HIGH" and open PNP inputs are always "LOW".

Menu		Setting Range	Default
bASE	**Time base / Resolution of the timer**		SEC.000
	Milliseconds	SEC.000	
	1/100 seconds	SEC.00	
	1/10 seconds	SEC.0	
	Integer seconds	SEC	
	Minutes with two decimal positions	min.00	
	Minutes with one decimal position	min.0	
	Hours : minutes : seconds	H-m-S	
StArt	**Start / Stop of time measurement**		St_SP
	Time count is active while input A is HIGH.	Hi_Lo	
	Rising edge on input A starts count. Rising edge on input B stops count.	St_SP	
	Period time measurement. Repeating display of the time between two rising edges on input A.	A_StSP	
rESEt	**Auto Reset**		no
	Time count goes on and never restarts. No automatic Reset. Use the Reset input to set to zero.	no	
	Every start initializes a new count starting from zero.	yES	
LAtcH	**Latch Function**		no
	Real time display, count visible.	no	
	Frozen display of the final count result after every Stop. The timer counts in the background.	yES	

7.2.4 Count, Counter mode

Menu		Setting Range	Default
modE	**Counting Mode**		A_b .1
	Input A counts and input B selects the counting direction (LOW = increment, HIGH = decrement).	A_bdir	
	Summing counter, A + B.	A u b	
	Differential counter, A – B.	A - b	
	Quadrature up/down counter A/B with single edge count (x1).	A_b .1	
	Quadrature up/down counter A/B with double edge count (x2).	A_b .2	
	Quadrature up/down counter A/B with (x4) edge count.	A_b .4	
FActor	**Impulse Scaling Factor** Example: setting 1.2345 results in display of 12 345 after 10 000 input pulses.	0.0001 ... 9.9999	**1.0000**
SEt	**Set Value** Every Reset signal will set the display to the value entered here.	–199 999 ... 999 999	**0**
rESEt	**Reset/Set Enable**		Fr u E
	No setting or resetting of the counter is possible.	no	
	Set / Reset by the front **SET** key.	Front	
	Set / Reset by remote signal to the Reset input.	E_tErn	
	Set / Reset by front **SET** key and by external input.	Fr u E	
dPoint	**Decimal Point** Select the desired position as shown in the display.		**000.000**
	no decimal point	000000	
	one decimal position	00000.0	
	---->		
	five decimal positions	0.00000	

NOTE

- The counting range of the unit is limited from -199999 to 999999. In case of underflow or overflow the unit will display ------.
- The counter stores all counting data also in power-down state (EEProm with data retention >10 years).
- With the summing mode (A+B) and the differential mode (A-B) please note that the impulse scaling factor will only affect input A.

7.2.5 Speed from differential time between a Start and a Stop input

Input A operates as a start input and input B operates as a Stop input. The differential time between start and stop will be converted into the speed of the passing object.

Menu		Setting Range	Default
timE	**Time** Enter a typical delay time which you expect between the start and stop signals.	000.001 ... 999.999 sec	**1.000 sec**
diSPL	**Display Value** Enter the speed you would like to see in the display when an object passes within above time.	000.001 ... 999.999	**1.000**
dPoint	**Decimal Point** Select the desired position as shown in the display. no decimal point one decimal position ---->> five decimal positions	 000000 00000.0 0.00000	**000.000**
WAit	**Wait Time** How long should the last result remain in the display before it returns to zero? Set the desired waiting time. With setting "0" the display will freeze and wait until to the next measuring cycle.	0.00 ... 9.99	**1.00**

7.2.6 Linearization points

The linearization points will only appear with "RPM" or "Count" operation modes when Linearization is enabled.

Menu		Setting Range	Default
P01_X	**Linearization point 1** X value of the first interpolation point.	-199999 ... 999999	**999999**
P01_Y	**Linearization point 1** Y value of the first interpolation point.	-199999 ... 999999	**999999**
	... **...**		
P16_X	**Linearization point 16** X value of the 16. interpolation point.	-199999 ... 999999	**999999**
P16_Y	**Linearization point 16** Y value of the 16. interpolation point.	-199999 ... 999999	**999999**

For more details about linearization please refer to section "8.1 Linearization" on page 30.

7.3 Model LD301: additional settings for the analogue output

The Basic menu provides the following additional settings:

Menu		Setting Range	Default
A-ChAr	**Analogue characteristics** Select one of the following options: +/-10 V (bipolar) 0-10 V (positive output only) 4-20 mA current output. 0-20 mA current output When you set the output to +/-10 Volts, your input signals A/B must be of quadrature type with phase displacement. The polarity of the output follows the sign in the display (operation as a counter or as a speed display with detection of direction of rotation).	 - 10_ 10 0_ 10 4_20 0_20	0_ 10
OFFSEt	**Analog Offset *** Set this register to "0" when your output range should begin at zero (or 4 mA) If you desire another initial output value, set this register correspondingly. Setting 5.000 means your output will start at 5 Volts instead of zero.	-9.999 ... +9.999	**0.000**
GAin	**Analog Gain *** Set the analogue stroke you desire: setting 1000 means 10 Volts or 20 mA. Setting 200 reduces the stroke to 2 Volts or 4 mA.	00.00 ... 99.99	**10.00**

* See next page for more details.

Response time of the analogue output:

Operation mode	Response time analogue output
Tachometer, frequency meter (see section "7.2.1 RPM, operation as tachometer or frequency counter" on page 16)	330ms at f >3Hz 1/f at f < 3Hz
Baking time / processing time indicator (see section "7.2.2 Time, display of baking or processing time (reciprocal speed)"on page 17)	330ms at f >3Hz 1/f at f < 3Hz
Timer, Stopwatch (see section "7.2.3 Timer, Stopwatch" on page 18)	7 ms (With latch function after every measurement)
Counter for position or event (see section "7.2.4 Count, Counter mode" on page 19)	Counter value + 7ms
Speed calculation from differential transition time (see section "7.2.5 Speed from differential time between a Start and a Stop input" on page 20)	Runtime + 7ms

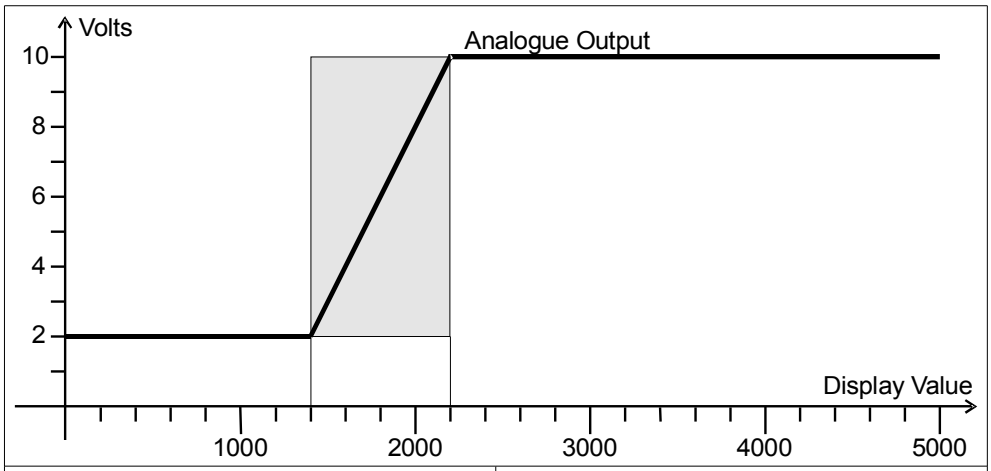
The analogue output behaves like the display output.

The following Operational Parameters provide scaling of the analogue output:

Menu		Setting Range	Default
AnAbEG	**Analog-Begin** Start value of the analog output.	-199999 ... 999999	**0**
AnAEnd	**Analog-End** End value of the analog output.	-199999 ... 999999	**10000**

By means of these two parameters any window of the whole display range can be mapped onto the analogue output.

The subsequent example shows how to convert the display range from 1400 to 2200 into an analogue signal of 2 - 10 volts.



A-ChAr = 0 - 10 V	AnAbEG = 1400
OFFSEt = 2.000	AnAEnd = 2200
GAin = 8.00	

NOTE
All settings refer to the scaled values which are shown in the display of the unit.

7.4 Model LD302: additional settings for preselections

The basic setup menu provides the following additional parameters:

Menu		Default
CHAr 1	**Switching characteristics of output 1**	__r GE
	__r GE **Greater/Equal:** output to switch **statically** "ON" when display value ≥ preset value.	
	__r LE **Lower/Equal:** output to switch **statically** "ON" when display value ≤ preset value.	
	_n_ GE **Greater/Equal:** output to switch **dynamically** "ON" when display value ≥ preset value. (timed pulse output *)	
	_n_ LE **Lower/Equal:** output to switch **dynamically** "ON" when display value ≤ preset value. (timed pulse output *)	
	_n_ rES **Reset:** Timed impulse output *) and automatic Reset to zero when the display value reaches Preset 1.	
	_n_ SEt **Set:** Timed impulse output *) and automatic setting to preset 1 when the display value reaches zero.	
CHAr 2	**Switching characteristics of output 2**	__r GE
	__r GE See CHAr 1.	
	__r LE See CHAr 1.	
	_n_ GE See CHAr 1.	
	_n_ LE See CHAr 1.	
	__r 1-2 Output switches **statically** ON when display value ≥ Preset 1 – Preset 2 **.	
	_n_ 1-2 Output switches **dynamically** ON when display value ≥ Preset 1 – Preset 2 **.	
HYSt 1	**Hysteresis 1:** adjustable hysteresis for output 1 ***. Setting range 0 ... 99999 display units.	0
HYSt 2	**Hysteresis 2:** adjustable hysteresis for output 2 ***. Setting range 0 ... 99999 display units.	0

* Fixed pulse duration of 500 msec (factory adjustable only).

** This feature is meant to generate an anticipation signal with a fixed distance to the preset 1 signal. The anticipation automatically follows the setting of preset 1 (trailing preset).

*** Switching hysteresis is only active with "RPM" and "Time" operation modes.

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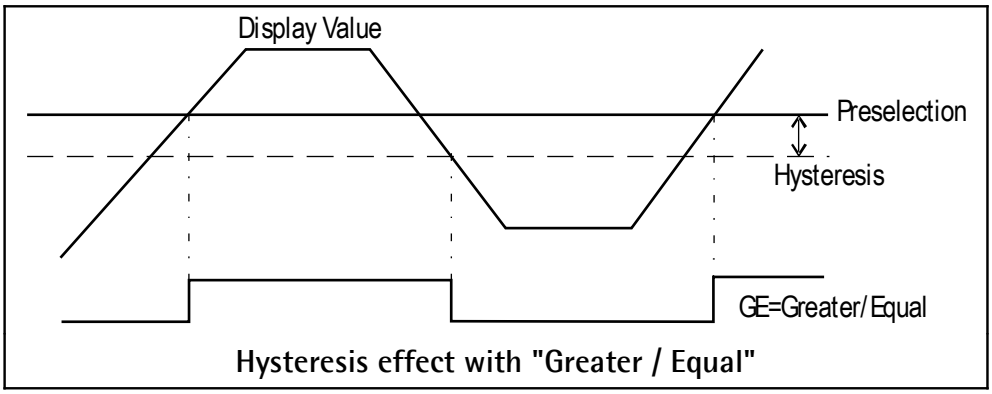
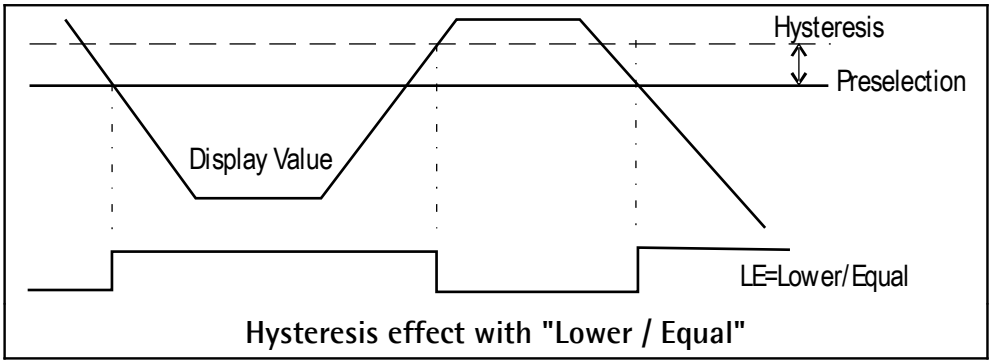
The following operational parameters provide setting of the switching points:

Menu		Setting Range	Default
PrES_1	**Preselection 1**	-199999 ... 999999	**10000**
PrES_2	**Preselection 2**	-199999 ... 999999	**5000**

The working direction of the Hysteresis depends on the setting of the switching characteristics.
With settings „GE" or „LE" respectively, the following switch points will result:



Hysteresis effect with "Greater / Equal"



Hysteresis effect with "Lower / Equal"

It is possible to check up on the actual switching state of the outputs at any time.
For this, just tap on the **ENTER** key shortly.
The display will then show for the next two seconds one of the following information:

Display	Meaning	
1_2oFF	Both outputs are actually off.	
1_2on	Both outputs are actually on.	
1 on	Output 1 is on.	Output 2 is off.
2on	Output 1 is off.	Output 2 is on.

7.5 Model LD303: additional settings for the serial interface

The basic setup menu contains the main parameters for configuration of the serial interface.

Menu		Setting Range	Default
S-Unit	**Serial Unit Number** You can assign any address number between 11 and 99 to your unit. The address must <u>not</u> contain a "0" because such numbers are reserved for collective addressing.	0 ... 99	**11**
S-Forn	**Serial data format** The first character indicates the number of Data Bits. The second character specifies the Parity Bit ("even" or "odd" or "none") The third character indicates the number of Stop Bits.	7 E 1 7 E 2 7 O 1 7 O 2 7 no 1 7 no 2 8 E 1 8 O 1 8 no 1 8 no 2	7 E 1
S-bAUd	**Baud rate** The following baud rates can be selected.	9600 4800 2400 1200 600 19200 38400	9600

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The following operational parameters provide setting of the communication profile:

<table>
<tr><th>Menu</th><th></th><th>Setting Range</th><th>Default</th></tr>
<tr><td>S-tim</td><td>Serial Timer
Setting 0.000 allows manual activation of a serial data transmission at any time. All other settings specify the cycle time for automatic transmission (provided the S-mod item is set to "Printer-mode" (see the next item and on page 29).

Between two transmission cycles the unit will allow a pause depending on the baud rate. The minimum cycle times for timer transmissions are shown in the table.

<table>
<tr><th>Baud Rate</th><th>Minimum Cycle Time [msec]</th></tr>
<tr><td>600</td><td>384</td></tr>
<tr><td>1200</td><td>192</td></tr>
<tr><td>2400</td><td>96</td></tr>
<tr><td>4800</td><td>48</td></tr>
<tr><td>9600</td><td>24</td></tr>
<tr><td>19200</td><td>12</td></tr>
<tr><td>38400</td><td>6</td></tr>
</table></td><td>0.000;
0.010 ...
9.999 sec</td><td>0.1 sec</td></tr>
<tr><td>S-mod</td><td>Serial Mode

Operation according to communication profile (see section “7.5.1 PC-Mode” on page 27).
Transmission of string type 1 (see section “7.5.2 Printer-Mode” on page 29).
Transmission of string type 2 (see section “7.5.2 Printer-Mode” on page 29).</td><td>PC
Print 1
Print2</td><td>PC</td></tr>
<tr><td>S-CodE</td><td>Serial Register-Code

Specifies the register code of the data to be transmitted. The most important register codes are the actual display value and the serial Set/Reset command code.

<table>
<tr><th>Register</th><th>S-Code</th><th>ASCII</th></tr>
<tr><td>Actual display value</td><td>101</td><td>: 1</td></tr>
<tr><td>Activate SET /RESET</td><td>60</td><td>6 0</td></tr>
</table></td><td>100
...
120</td><td>101</td></tr>
</table>

7.5.1 PC-Mode

Communication in PC mode allows free readout of all parameters and registers of the unit. The subsequent example shows the details of communication for serial readout of the actual display value.

This is the general format of a serial request string:

EOT		AD1	AD2	C1	C2	ENQ

EOT = Control character (Hex 04)
AD1 = Unit address, High Byte
AD2 = Unit address, Low Byte
C1 = Register code, High Byte
C2 = Register code, Low Byte
ENQ = Control character (Hex 05)

Example

Request for the actual display value from unit number 11.

ASCII-Code	EOT	1	1	:	1	ENQ
Hexadecimal	04	31	31	3A	31	05
Binary	0000 0100	0011 0001	0011 0001	0011 1010	0011 0001	0000 0101

Upon correct request the unit will respond as shown on the right. Leading zeros will be suppressed.
BCC represents a block check character generated from an Exclusive-OR of all characters from C1 through ETX (inclusively).

STX	C1	C2	x x x x x x x	ETX	BCC

STX = Control character (Hex 02)
C1 = Register code, High Byte
C2 = Register code, Low Byte
x x x x x = Register data
ETX = Control character (Hex 03)
BCC = Block check character

With incorrect request strings, the unit only responds STX C1 C2 EOT or just NAK.

Provided the actual display value of the unit is "-180" for instance, the full response of the unit will be as shown below:

ASCII	STX	:	1	-	1	8	0	ETX	BCC
Hex	02	3A	31	2D	31	38	30	03	1C
Binary	0000 0010	0011 1010	0011 0001	0010 1101	0011 0001	0011 1000	0011 0000	0000 0011	0001 1100

Again BCC represents the block check character formed from the Exclusive-OR of all characters from C1 through ETX.

Units with serial link also allow setting or resetting the counter by serial command (similar to the external input or front key function). To activate the Reset command, please write "1" to register code "60". To release the Reset command again, write "0" to the same register.

Example

The following strings show how to set or reset a unit with unit No. 11:

Reset ON:

ASCII	EOT	AD1	AD2	STX	C1	C2	Data	ETX	BCC
Hex	04	31	31	02	36	30	31	03	34
Binary	0000 0100	0011 0001	0011 0001	0000 0010	0011 0110	0011 0000	0011 0001	0000 0011	0011 0100

Reset OFF:

ASCII	EOT	AD1	AD2	STX	C1	C2	Data	ETX	BCC
Hex	04	31	31	02	36	30	30	03	35
Binary	0000 0100	0011 0001	0011 0001	0000 0010	0011 0110	0011 0000	0011 0000	0000 0011	0011 0101

For more details about serial communication please refer to the additional documentation.

7.5.2 Printer-Mode

The Printer mode allows cyclic or manual activation of transmissions of the specified register data. The corresponding register can be specified by means of parameter **S-CodE**.
Another parameter called **S-mod** allows the selection between two different string types:

„S-mod"	Transmission string type
„Print1"	Space | Sign | Data | Line feed | Carriage return ( ) | +/- | X X X X X X | LF | CR
„Print2"	Sign | Data | Carriage return +/- | X X X X X X | CR

The mode of activation of serial transmissions can be determined as follows:

Cyclic (timed) transmissions	Set the **S-tim** item (see on page 25) to any value ≥ 0.010 sec. Select the desired string type next to parameter **S-mod**. After exiting the menu the timed transmissions will start automatically.
Manual activation of transmissions	Set the **S-tim** item (see on page 25) to 0.000. Select the desired string type by parameter **S-mod**. After exiting the menu a transmission can be activated at any time by shortly pressing the **ENTER** key.

8 Special functions

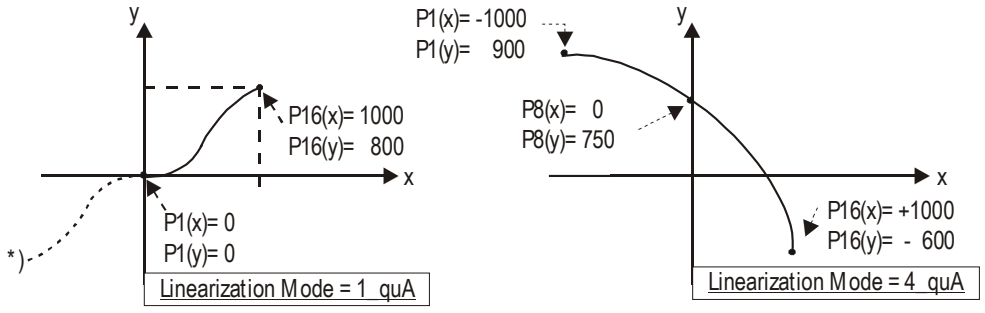
8.1 Linearization

This function allows a non-linear input signal to be converted into a linear representation or vice versa. 16 interpolation points are available, they can be freely arranged over the whole measuring range at any distance. Between two points the unit will interpolate automatically straight lines.
It is advisable to set several points into areas with strong bending and to use only a few points in areas with little bending. "**Linearisation Mode**" has to be set to either 1-quA or 4-quA (see LinEAr item in section "7.1 Basic settings") to enable the linearization function (see subsequent drawing).
Parameters P0 1_x to P 16_x select 16 x- coordinates, representing the display values which the unit would normally show in the display. With parameters P0 1_y to P 16_y you can specify which values you would like to display instead of the corresponding _x values.

This means e.g. that the unit will replace the previous P02_x value by the new P02_y value.

NOTE

- With respect to the consistency of the linearization, the x- registers have to use continuously increasing values, e.g. the x- registers must conform to the constraint P0 1_x < P02_x < ... < P 15_x < P 16_x.
- Independently of the selected linearization mode, the possible setting range of all registers P0 1_x, P0 1_y,..., P 16_x, P 16_y is always -199999 ... 999999.
- With measuring values lower than P0 1_x the display will always show P0 1_y.
- With measuring values higher than P 16_x, the display will always show P 16_y.



* Mirror of positive range

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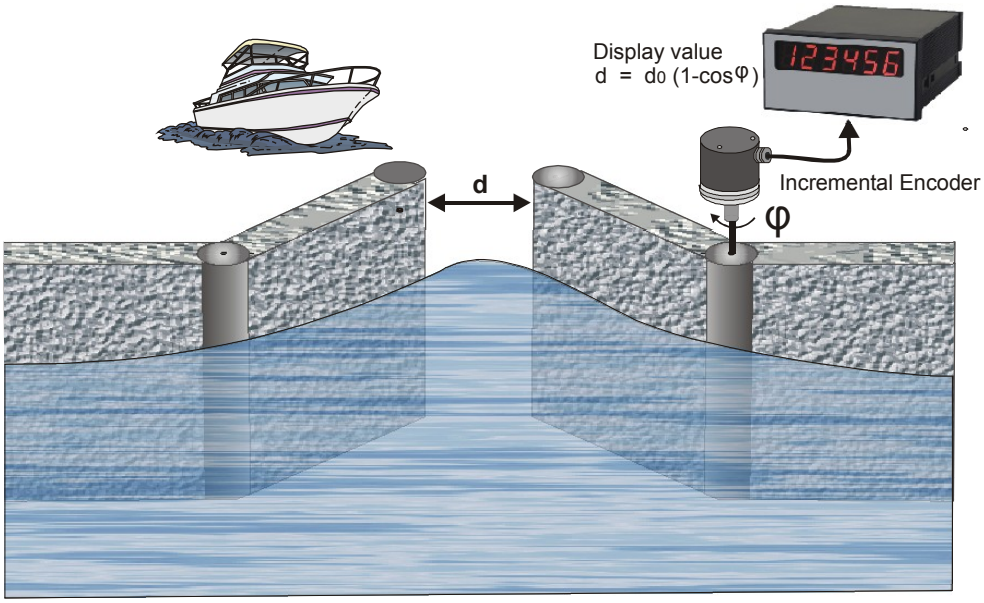
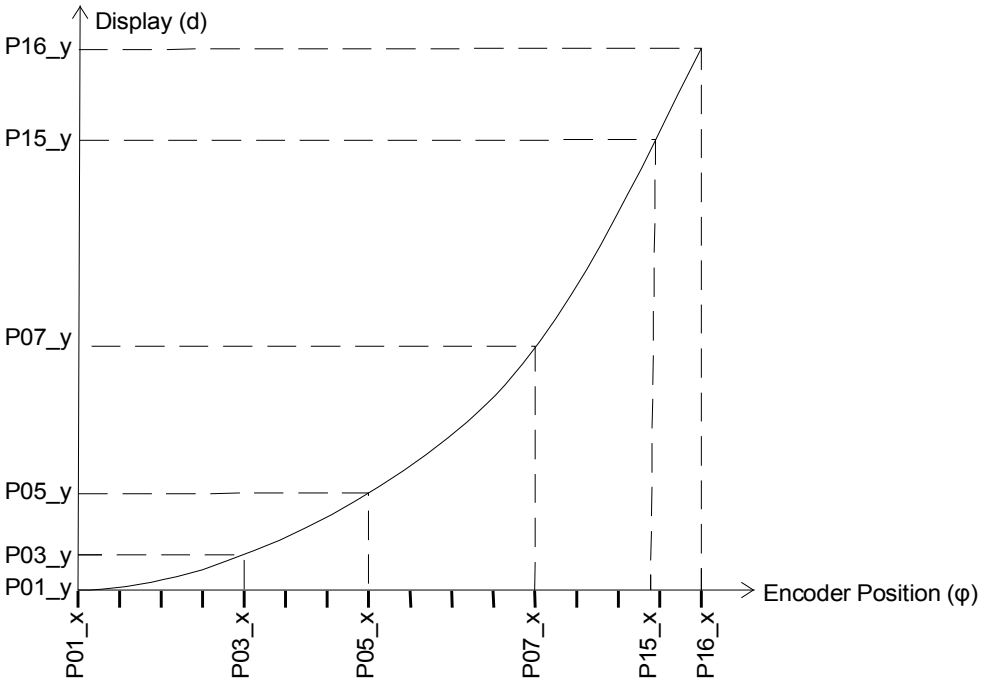
EXAMPLE

The picture below shows a sluiceway where the gate is controlled by means of an incremental encoder. We would like to display the clearance of the gate "d", but the existing encoder information is proportional to the angular information φ.





8.2 Manual input or „teaching" of the interpolation points

Interpolation points to form the linearization curve can be entered one after each other, using the same procedure as for all other numeric parameters. This means you will have to enter all parameters P01_x to P16_x and P01_y to P16_y manually using the keypad.

WARNING
During manual input of interpolation points the unit will not examine the settings P01_x to P16_x. Therefore the operator is responsible for adherence to the constraint P01_x < P02_x < ... < P15_x < P16_x.

In most cases it should however be much more convenient to use the Teach function.
For this method we have to move the encoder, step by step, from one interpolation point to the next. After each step we enter the desired display value through the keypad.

How to use the "Teach" function

- Please select the desired range of linearization (see section "7.1 Basic settings").
- Hold down the **CMD** key for 3 seconds, until the display shows tEACh. Now the unit has switched over to the Teach mode. To start the teach procedure please press again the **CMD** key within the next 10 seconds. The display will then show P01_X.
- With respect to the consistency required for linearization, all parameters from P01_x to P16_ y will be overwritten by suitable initial values first. Initial values for P01_x and P01_y are -199999 and all other values will start with 999999.
- Press once more **CMD** key to display the actual encoder position. Then move the encoder to the first of the desired interpolation points.
- When you read the x-value of your first interpolation point in the display, press **CMD** key again. This will automatically store the actual display value in the P01_x register. For about 1 second you will read P01_Y on the display, followed by the same reading again that has been stored previously.
- This display value now can be edited like a regular parameter and you can change it to the desired P01_y value.
- When you read the desired P01_y value in your display, save it by pressing **CMD** key again. This will cause the display to automatically scroll to the next interpolation point P02_x.

- Once we have reached and stored the last interpolation points P 16_x/y, the routine will restart with P01_x again. You are free to double-check your settings once more or to make corrections.
- To finish the Teach procedure, keep **ENTER** key down for about 2 seconds. In the display you will read StOP for a short time and then the unit returns to the normal operation. At the same time all linearization points have been finally saved.

NOTE

- The unit will examine the constraint valid for the x-values of interpolation points. Every interpolation point must be higher than its preceding point. If this constraint is breached, all 6 decimal points will blink automatically as a warning. Pressing the **CMD** key will not store the illegal value, but result in an error text E.r.r.-.L.0..
- To exit the teach mode again, you have the following two possibilities:
  1. Press the **ENTER** key for 2 seconds. On the display you will read StOP for a short time and then the unit will switch back to the normal mode.
  2. Just do nothing. After 10 seconds the unit will switch back to the normal mode automatically. In both cases the parameters of linearization P01_x to P 16_y will not change.

9 Parameters list

9.1 General

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
See section "7.1 Basic settings" on page 14							
Unit Type	tYPE	0	4	0	1	0	00
Characteristic	CHAr	0	1	1	1	0	01
Brightness	briGht	0	4	0	1	0	02
Code	CodE	0	2	0	1	0	03
See section "7.2.1 RPM, operation as tachometer or frequency counter" on page 16							
Frequency (Hz)	FrEqu	1	25000	1000	5	0	04
Display Value	diSPL	1	99999	1000	5	0	05
Decimal point	dPoint	0	5	3	1	0	06
Wait Time (sec)	WAit	1	999	10	3	1	07
Average Filter	FiLtEr	0	4	0	1	0	08
See section "7.2.2 Time, display of baking or processing time (reciprocal speed)" on page 17							
Display Format	diSFor	0	3	0	1	0	09
Frequency (Hz)	FrEqu	1	25000	100	5	0	10
Display Value	diSPL	1	999999	100	6	0	11
Wait Time (sec)	WAit	1	999	50	3	1	12
Average Filter	FiLtEr	0	4	0	1	0	13
See section "7.2.3 Timer, Stopwatch" on page 18							
Base	bASE	0	6	0	1	0	14
Start / Stop	StArt	0	2	1	1	0	15
Auto Reset	rESEt	0	1	0	1	0	16
Latch Function	LAtcH	0	1	0	1	0	17
See section "7.2.4 Count, Counter mode" on page 19							
Count Mode	ModE	0	5	3	1	0	18
Factor	FActor	1	99999	10000	5	4	19
Set Value	SEt	-199999	999999	0	86	0	20
Reset / Set	rESEt	0	3	3	1	0	21
Decimal point	dPoint	0	5	0	1	0	22
See section "7.2.5 Speed from differential time between a Start and a Stop input" on page 20							
Measuring Time (sec)	timE	1	999999	1000	6	3	23
Display Value	diSPL	1	999999	1000	6	0	24
Decimal point	dPoint	0	5	0	1	0	25
Wait Time (s)	WAit	0	999	100	3	1	26

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9.2 Linearization

See section "7.2.6 Linearization points" on page 20

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
L_Mode	LrnodE	0	2	0	1	0	D2
P1(x)	P01_H	-199999	999999	999999	86	0	A0
P1(y)	P01_Y	-199999	999999	999999	86	0	A1
P2(x)	P02_H	-199999	999999	999999	86	0	A2
P2(y)	P02_Y	-199999	999999	999999	86	0	A3
P3(x)	P03_H	-199999	999999	999999	86	0	A4
P3(y)	P03_Y	-199999	999999	999999	86	0	A5
P4(x)	P04_H	-199999	999999	999999	86	0	A6
P4(y)	P04_Y	-199999	999999	999999	86	0	A7
P5(x)	P05_H	-199999	999999	999999	86	0	A8
P5(y)	P05_Y	-199999	999999	999999	86	0	A9
P6(x)	P06_H	-199999	999999	999999	86	0	B0
P6(y)	P06_Y	-199999	999999	999999	86	0	B1
P7(x)	P07_H	-199999	999999	999999	86	0	B2
P7(y)	P07_Y	-199999	999999	999999	86	0	B3
P8(x)	P08_H	-199999	999999	999999	86	0	B4
P8(y)	P08_Y	-199999	999999	999999	86	0	B5
P9(x)	P09_H	-199999	999999	999999	86	0	B6
P9(y)	P09_Y	-199999	999999	999999	86	0	B7
P10(x)	P 10_H	-199999	999999	999999	86	0	B8
P10(y)	P 10_Y	-199999	999999	999999	86	0	B9
P11(x)	P 11_H	-199999	999999	999999	86	0	C0
P11(y)	P 11_Y	-199999	999999	999999	86	0	C1
P12(x)	P 12_H	-199999	999999	999999	86	0	C2
P12(y)	P 12_Y	-199999	999999	999999	86	0	C3
P13(x)	P 13_H	-199999	999999	999999	86	0	C4
P13(y)	P 13_Y	-199999	999999	999999	86	0	C5
P14(x)	P 14_H	-199999	999999	999999	86	0	C6
P14(y)	P 14_Y	-199999	999999	999999	86	0	C7
P15(x)	P 15_H	-199999	999999	999999	86	0	C8
P15(y)	P 15_Y	-199999	999999	999999	86	0	C9
P16(x)	P 16_H	-199999	999999	999999	86	0	D0
P16(y)	P 16_Y	-199999	999999	999999	86	0	D1

9.3 Analogue output (model LD301)

See section "7.3 Model LD301: additional settings for the analogue output" on page 21

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Analogue Start	An-bEG	-199999	999999	0	86	0	31
Analogue End	An-End	-199999	999999	10000	86	0	32
Analogue Mode	A-CHAr	0	3	1	1	0	33
Offset	OFFSEt	-9999	9999	0	84	3	34
Gain	GAin	0	9999	1000	4	2	35

9.4 Preselections (model LD302)

See section "7.4 Model LD302: additional settings for preselections" on page 23

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Preselection Value 1	PrES 1	-199999	999999	10000	86	0	27
Preselection Value 2	PrES2	-199999	999999	5000	86	0	28
Preselection Mode 1	CHAr 1	0	5	0	1	0	29
Preselection Mode 2	CHAr2	0	5	0	1	0	30
Hysteresis 1	HySt 1	0	99999	0	5	0	31
Hysteresis 2	HySt2	0	99999	0	5	0	32

9.5 Serial interface (model LD303)

See section "7.5 Model LD303: additional settings for the serial interface" on page 25

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Serial Timer (s)	S-tim	0	9999	100	4	3	38
Serial Mode	S-mod	0	2	0	1	0	39
Serial Code	S-CodE	100	120	101	3	0	40
Serial Unit Nr	S-Unit	0	99	11	2	0	90
Serial Format	S-Forn	0	9	0	1	0	92
Serial Baud rate	S-bAUd	0	6	0	1	0	91

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